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Publication Title:

SELF-ADJUSTING CUFF DEVICE

Abstract:

Abstract of WO8804543

A dynamic support (1, 40) in which there is provided fitting system (2, 3) for engaging body parts articulated to each other, arms (4, 5) attached to an extending from the fitting system and movably attached to each other remote from the fitting system, and a tightening system (14, 71, 21, 6, 25) attached to the fitting system and arms for dynamically and temporarily tightening the fitting system on the body parts in response to movement of one body part relative to the other body part.

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(71)(72) Applicant and Inventor: SPADEMAN, Richard, G. [US/US]; P.O. Box 6410, Incline Village, NV 89450 (US).

(74) Agent: HANN, James, F.; Townsend and Townsend, One Market Plaza, 2000 Steuart Tower, San Francisco, CA 94105 (US).

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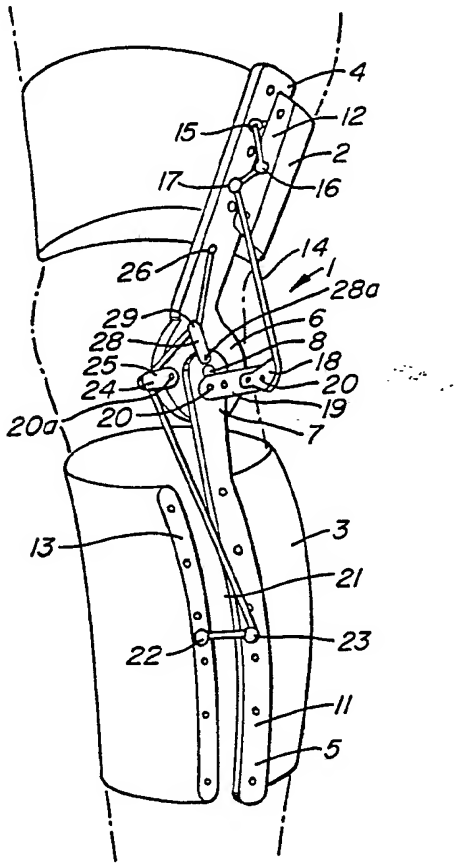
A dynamic support (1, 40) in which there is provided fitting system (2, 3) for engaging body parts articulated to each other, arms (4, 5) attached to an extending from the fitting system and movably attached to each other remote from the fitting system, and a tightening system (14, 71, 21, 6, 25) attached to the fitting system and arms for dynamically and temporarily tightening the fitting system on the body parts in response to movement of one body part relative to the other body part.



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Self-Adjusting Cuff Device

BACKGROUND OF THE INVENTION

The present invention relates to therapeutic and prophylactic devices, particularly to a cuff device or dynamic support that temporarily tightens and loosens on a wearer's body part as another body part is moved.

Various compressive cuff devices are known such as the straps that hold braces on a patient's limb and trunk to protect ligaments, tendons and bones as they heal following injury or surgery. Various strapping devices are also used to help prevent injury or provide support for the chronic instability of a body part. Elastic stockings and inflatable cuffs are used to reduce edema and blood stasis in the extremities that result from disease, injury, prolonged confinement or surgery.

Unfortunately, at the present time, ideal conditions for the efficient application of these braces, cuffs and stockings cannot be achieved with conventional means. These supporting structures tend to be either too loose on the body part, in which case the support members cannot adequately stabilize the body part against undesirable or abnormal movement or fluid stasis or, more frequently, these supporting structures are held too tightly, intensifying discomfort, prolonging immobility and aggravating the problem of stasis or atrophy.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a cuff device or dynamic support that overcomes the drawbacks of previously known devices of the above known type.

Another object of the present invention is to provide a dynamic support that momentarily tightens on

a body part in response to movement of another body part.

It is still another object of the present invention to provide a dynamic support that temporarily tightens and loosens from a close fit or snug fit position on a body part in response to movement of another body part in desirable directions but not in other directions.

It is still another object of the present invention to provide a dynamic support that can be adjusted to control the rate and amount of tightening and loosening of the dynamic support on a body part in response to a predetermined movement in a predetermined direction from a predetermined position of another body part.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a perspective view of a cuff assembly or dynamic support of the present invention in the resting position showing the various parts.

Fig. 2 is an enlarged fragmentary side elevation view of the dynamic support showing the pivot, lever and cam assembly.

Fig. 3 is a vertical sectional view taken along line A-A of Fig. 2.

Fig. 4 is an enlarged fragmentary side elevation view of the dynamic support of an alternative embodiment of the present invention showing the pivot and gear assembly.

Fig. 5 is an enlarged fragmentary side elevation view of the dynamic support of another alternative embodiment of the present invention showing the pivot and plate assembly in the normal position.

Fig. 6 is an enlarged fragmentary side elevation view of the dynamic support of Fig. 5 pivoted from the normal position.

Fig. 7 is a vertical sectional view taken along line B-B of Fig. 6.

Fig. 8 is an enlarged view of an alternative embodiment of the portion of the dynamic support of Fig. 5 identified by line C-C.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 1-3, a cuff device or dynamic support for the lower extremity is shown, but it is understood that the principles of the invention are also applicable to other articulated body parts. There is shown in Fig. 1 a dynamic support 1 which includes an upper limb engaging cuff component 2 and a lower limb engaging cuff component 3. These cuff components comprise a fitting system and are respectively adapted to engage the body parts above and below the body articulation. A pair of arms 4 and 5 are respectively attached to and extend toward each other from the limb engaging cuff components 2 and 3. These arms 4 and 5 terminate in movable overlapping end regions 6 and 7 remote from the cuff components and are formed with aligned openings through which a single pivot pin 8 extends. More complex slidable and pivotable orthotic joints can be used and additional arms can be located on the limbs. The pivot pin 8 has a head 9 and a section 10 secured in the opening in the end region 6 by a hexagonal shaped configuration complementary to a hexagonal shaped opening in end region 6. End region 7 pivots freely about pivot pin 8. Thus, pivot pin 8 forms a pivot axis which is substantially perpendicular to the arms 4 and 5 and which coincides with the predominant axis to which swinging of the upper and lower limbs are limited. The arms 4 and 5 may be of a slightly flexible material construction such as metal or plastic. The cuff components 2 and 3 are fixed at one end to the arms 4 and 5 by rivets 11 or the like. The cuff components are constructed of relatively soft yieldable

material such as plastic or cloth to conform to the limb configuration. The opposite ends of the cuff components 2 and 3 are fixed to relatively stiff bars 12 and 13 by rivets 11 or the like.

A cable 14 is releasably and adjustably secured with a cable clamp bolt 15 head on arm 4, passes through a guide 16 on bar 12, passes through guide 17 on arm 4 and is directed in a groove around cam 18 of a lever mechanism 71. The cable is then secured to the lower end of the cam 18 by a cable clamp bolt head to provide a snug fit of the upper limb engaging cuff component and to prevent loosening of the cuff component from the snug fit position. The cam 18 is attached by bolts 20 or the like to lever 19 which is attached to end region 7 by bolts 20 or the like. The cable cam and lever can be constructed in various shapes and lengths to adjust the amount and rate of tightening of the cuff components and comprises a tightening system.

A cable 21 is secured under cable clamp bolt head 22 on bar 13, passes through guide 23 on arm 5 and is directed through guide 24 on lever 25 attached to end region 6 by bolt 20a or the like. The cable is then releasable and adjustably secured under a cable clamp bolt head 26 on arm 4 to provide a close fit of the lower cuff component. A lever 28 is adjustably attached to end region 7 by a bolt 28a or the like and engages the cable 21 by a guide 29. The levers 25 and 28 of the tightening system can be adjusted such that the cuff component 3 is tightened from the snug fit when the first body part is moved away from a predetermined position relative to the articulated second body part. In this instance tightening occurs in both flexion and extension of the thigh relative to the leg from the resting position.

In use, the dynamic support is placed on the wearer s limb by situating the upper and lower arms 4 and 5 in the region of the knee or other body

articulation joint. The cuff components 2 and 3 are wrapped around the limbs and the cables 14 and 21 are adjustably secured under the appropriate cable clamp bolt heads 15 and 26. The dynamic support should fit snugly in the resting position for the articulation. The tightening system cable, lever and cam assembly is arranged and adjusted to tighten the cuff components when the body parts move in the direction of flexion and extension. However, numerous prophylactic and therapeutic conditions can be accommodated by various combinations and arrangements of the cables, levers and cams. One or both cuff components can be appropriately connected to the end regions to tighten in flexion or extension only or each in both directions from a predetermined position. One cuff device or dynamic support may serve to immobilize one arm and a tibia to prevent or restrain sliding or anterior and posterior movement of the tibia relative to the femur by arranging the system to dynamically tighten on the limbs in both flexion and extension. As another example, the dynamic support can serve to protect the knee from lateral bending and rotation by tightening both cuffs in extension of the extremity. Further, the tightening system can be arranged to first tighten the lower cuff component then the upper cuff component during the toe off and swing through phases of the wearer's gait to compress the limb to minimize stasis and improve venous return.

Referring to Fig. 4, there is provided in accordance with another embodiment of the present invention, a dynamic support designated generally as 30. Except as hereinafter described, the dynamic support 30 is substantially identical to the dynamic support 1 and operates in the same manner for dynamically and temporarily tightening the cuff components on the body parts. For convenience, those features of the dynamic support which are identical to those of the dynamic support of Figs. 1-3 are identified using the same numbers used in

Figs. 1-3. A pivot pin 8 is fixed in an opening in end region 6 and pivots freely in the opening in end region 7 as in the embodiment of Figs. 1-3. A gear 31 is removably attached to the shaft of pivot pin 8 and rotates with pivot pin 8 relative to end region 7. A gear 32 is rotatably and removably attached to end region 7 by a bolt 33 or the like and has teeth that mesh with cooperating teeth on gear 31. Cable 14 passes from an upper limb engaging cuff component (not shown) and is secured in a groove in gear 32. Thus, hinging end regions 6 and 7 cause the cable 14 to wind and unwind on gear 32 temporarily tightening and loosening the cuff component. Using interchangeable gears of various sizes, the rate and amount of tightening and loosening can be adjusted for the individual requirement. A lower limb engaging cuff component (not shown) may be held tightly in a static manner using a conventional strap and a Velcro® strip or additional cables, gears, cams and levers may be utilized to provide a tightening system for the lower limb.

Referring to Figs. 5-7 there is provided in accordance with still another embodiment of the present invention, a dynamic support designated generally as 40. Except as hereinafter described, the dynamic support 40 is substantially identical to the dynamic support 1 and operates in the same manner with a tightening system for dynamically and temporarily tightening the cuff components on the body parts. Those features of the dynamic support which are identical to those of the dynamic support of Figs. 1-3 are identified using the same numbers used in Figs. 1-3. Arms 4 and 5 and end regions 6 and 7 operate in the same manner as the arms and end regions in Figs. 1-3. A cuff component 42 is fixed at one end to the arm 4 by rivets 43 or the like. The cuff component 42 passes around the limb (not shown), passes through a loop 44 and is adjustably and releasably fixed to itself by a Velcro® strip 45 or the like. The loop 44 is attached to a cable 46 which passes through

guides 47 and 48 on arm 4 and is then directed around guide members 49 press fit in two of a series of holes 50 forming a cam plate in end region 7 and is releasably secured by a press fit hook 51 in one of the holes in end region 7 or a hole in pivot pin 8. Thus, hinging end regions 6 and 7 causes the cable 46 to tighten the cuff component 42 in a direction generally transverse to the long axis of the body part when the arms are pivoted from the resting position. By guiding the cable around guide members selectively placed in holes in the end region, the resting position and rate and amount of temporary tightening and loosening can be adjusted for the individual requirement. End region 7 includes a slot 52 to slidably engage a screw 53 attached in one of a series of threaded holes 54 in end region 6 to provide a stop to limit the extent of movement of hinging end regions 6 and 7. A cuff component complementary to cuff component 42 may be fixed to end region 5 or to an arm located on the opposite side of the body part and connected by an arm to dynamic support 40.

To increase the amount of tightening by cuff component 42, an arrangement such as shown in Fig. 8 can be used. Cable 46 is replaced by cable segments 46a, 46b. Cable segment 46a connects to loop 44 at one end, passes around a stationary guide 60, passes around a movable guide 62 and connects to a stationary peg 64 at the other end. Guide 60 and peg 64 are mounted to arm 4 while movable guide 62 is secured to the free end of cable segment 46b. Thus, movement of cable segment 46b one unit length pulls loop 44 two unit lengths. Other methods for increasing or decreasing the mechanical advantage of the embodiment of Figs. 5-7 can be used as well.

Details have been disclosed to illustrate the invention in a preferred embodiment of which adaption and modification within the spirit and scope of the invention will occur to those skilled in the art. For

instance, the upper cuff component may be placed around the body torso to encompass the abdomen and lower back and lower cuff components may be placed around the thighs with the end regions of the arms in the region of the hips. The cables, levers, and cams may be arranged as a tightening system and adjusted to temporarily tighten the cuff components when the back is moved in a direction of flexion and/or extension relative to a predetermined position of the back relative to the thighs. The scope of the invention is limited only by the following claims.

WHAT IS CLAIMED IS:

1. A dynamic support for first and second body parts which are articulated to each other comprising cuff components adapted to snugly engage the first and second body parts when the first and second body parts are in a resting position, the cuff components engaging the first and second body parts at locations spaced from the body area where the body parts are articulated, arms attached to and extending from each of the cuff components and terminating in end regions, said end regions being movably attached to each other at a point adjacent the area where the body parts are articulated, a tightening system attached to at least one of the cuff components and at least one end region; said dynamic support being characterized in that the tightening system includes members responsive to a predetermined relative movement between the body parts in at least one direction away from the resting position for increasing the tightness with which at least one of the cuff components engages at least one of the body parts.

2. A dynamic support according to claim 1 wherein the body parts are movable in opposite directions from the resting position and said tightening system temporarily increases the tightness with which at least one of the cuff components engages at least one of the body parts when at least one of the body parts moves in either one of the opposite directions.

3. A dynamic support according to claim 1 wherein said tightening system comprises movable means.

4. A dynamic support according to claim 1 wherein said tightening system comprises a cable and lever assembly operatively coupling at least one of the cuff components with the arms attached thereto.

5. A dynamic support according to claim 4 wherein said tightening system further comprises a cam mechanism.

6. A dynamic support according to claim 3 wherein said tightening system comprises a cable and gear assembly operatively coupling at least one of the cuff components with the arms attached thereto.

7. A dynamic support according to claim 3 wherein said tightening system comprises members responsive to a predetermined movement from the resting position in more than one direction of one body part relative to the other body part.

8. A dynamic support according to claim 3 wherein said tightening system responsive to a predetermined relative movement is responsive to a predetermined flexion and extension of one body part relative to the other body part.

9. A dynamic support according to claim 3 wherein said tightening system responsive to a predetermined relative movement is responsive to a predetermined flexion of one body part relative to the other body part.

10. A dynamic support according to claim 3 wherein said tightening system responsive to a predetermined relative movement is responsive to a predetermined extension of one body part relative to the other body part.

11. A dynamic support according to claim 3 wherein said tightening system responsive to a predetermined relative movement is responsive to a

predetermined sliding movement of one body part relative to the other body part.

12. A dynamic support according to claim 3 wherein said tightening system responsive to a predetermined relative movement is responsive to rotation of one body part relative to the other body part.

13. A dynamic support according to claim 3 wherein said tightening system responsive to a predetermined relative movement is responsive to a predetermined movement of the body leg relative to the body thigh.

14. A dynamic support according to claim 3 wherein said tightness increasing system temporarily increases the tightness of the fit between the cuff components and the body leg.

15. A dynamic support according to claim 3 wherein said tightness increasing system temporarily increases the tightness of the fit between the cuff component and the body thigh.

16. A dynamic support according to claim 1 wherein the cuff components comprise members for varying the tightness with which the cuff components engage the body parts when in the resting position.

17. A dynamic support according to claim 1 wherein the tightness increasing system temporarily increases the tightness with which at least one of the cuff components engages at least one of the body parts.

18. A dynamic support according to claim 1 wherein the arms comprise members for pivoting one arm relative to the other arm.

19. A dynamic support according to claim 1 wherein said tightening system comprises an adjustable cam and cable assembly operatively coupling the cuff components with the arms.

20. A dynamic support according to claim 19 wherein the cam and cable assembly comprises members for operatively coupling the cam and cable assembly to the end regions.

21. A dynamic support according to claim 20 wherein the cam and cable assembly further comprises a plate with multiple guide member holes.

22. A dynamic support according to claim 21 wherein the guide member holes releasably receive guide member pins.

23. A dynamic support according to claim 3 wherein said tightness increasing system increases the tightness of the fit in a direction generally transverse to a long axis of the body part.

24. A dynamic support according to claim 3 wherein said tightness increasing system adjusts the amount of tightening of at least one of the cuff components.

25. A dynamic support according to claim 19 wherein the cam and cable assembly comprises members for adjusting the relative position of the arms when the first and second body parts are in their resting positions.

26. A dynamic support according to claim 19 wherein the cam and cable assembly comprises members for limiting the extent of movement of the arms.

27. A dynamic support according to claim 26 wherein the members for limiting the extent of movement of the arms comprises stop members on the arms.

28. A dynamic support according to claim 27 wherein the stop members comprise a slot end in one arm and a screw member in the other arm.

29. A dynamic support for body parts articulated to each other comprising a fitting system for providing a close fit between the dynamic support and the body parts; arms attached to and extending from the fitting system and terminating in end regions movably attached to each other remote from the fitting system: a tightening system attached to the fitting system and the arms and responsive to a predetermined movement of one body part in more than one predetermined direction away from a predetermined position relative to the other body part for temporarily increasing the tightness of the fitting system on at least one of the body parts; members for varying the rate of tightening of the fitting system; and members for preventing a loosening of the fitting system.

30. A dynamic support according to claim 29 wherein the tightening system comprises an adjustable cam assembly.

31. A dynamic support according to claim 29 wherein the tightening system comprises members for adjusting the amount of tightening of the fitting system.

32. A dynamic support for first and second body parts of a body articulated to each other by a joint permitting generally pivotal movements of the parts about a pivot axis with respect to each other from a resting position in which the parts are in an

angular inclination relative to each other to a temporary position in which the parts are in a different angular inclination relative to each other, the support comprising cuff members engaging the first and second body parts in their resting position with a predetermined tightness, the cuff members being constructed so as to have a component on each side and spaced from the joint when applied to the first and second body parts of the patient, arms connected with the cuff members and having end regions, said arms in substantial alignment with the longitudinal axes of the body parts, and members pivotally securing the end regions of the arms to each other substantially coaxially with the pivot axis: a tightening system attached to the cuff members and the end regions of the arms for increasing the tightness with which the cuff members engages at least one of the body parts when they are moved away from the resting position towards the temporary position.

33. A dynamic support according to claim 32 including members for varying the rate at which the tightening system increases the tightness with which the cuff members engages at least one of the body parts.

34. A dynamic support according to claim 33 wherein the members for varying the rate includes an adjustable cam assembly.

35. A dynamic support for first and second body parts which are articulated to each other comprising cuff components adapted to snugly engage the first and second body parts when the first and second parts are in a resting position;

the cuff components engaging the first and second body parts at locations spaced from the body area where the parts are articulated;

arms attached to and extending from each of the cuff components and terminating in end regions; said end regions being movably attached to each other at a point adjacent the area where the body parts are articulated remote from the cuff components:

a tightening system attached to at least one of the cuff components and at least one arm; and

the tightening system including members responsive to a predetermined relative movement between the body parts in extension from the resting position for increasing the tightness with which at least one of the cuff components engages at least one of the body parts.

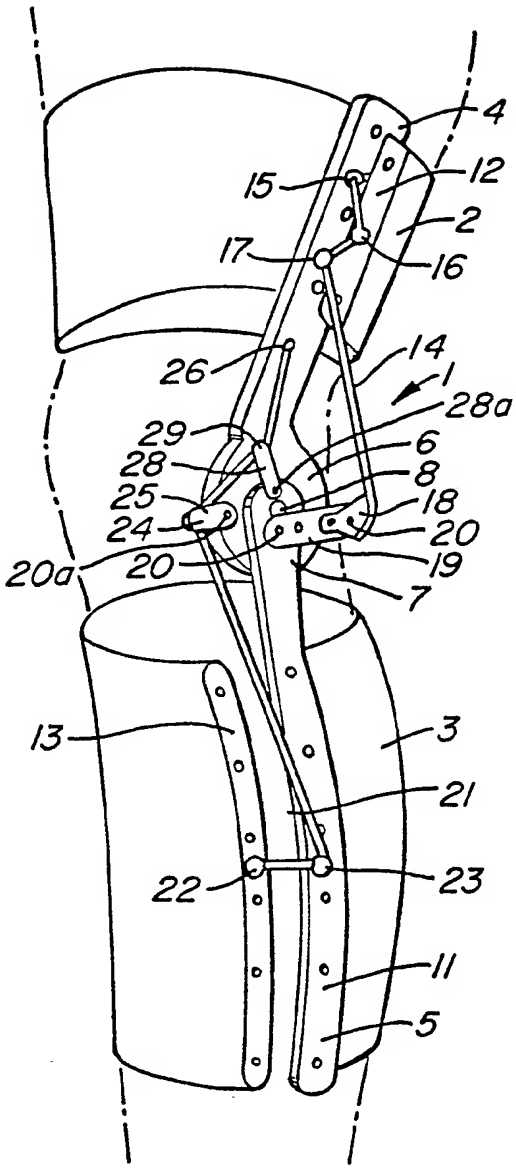

FIG.__1.

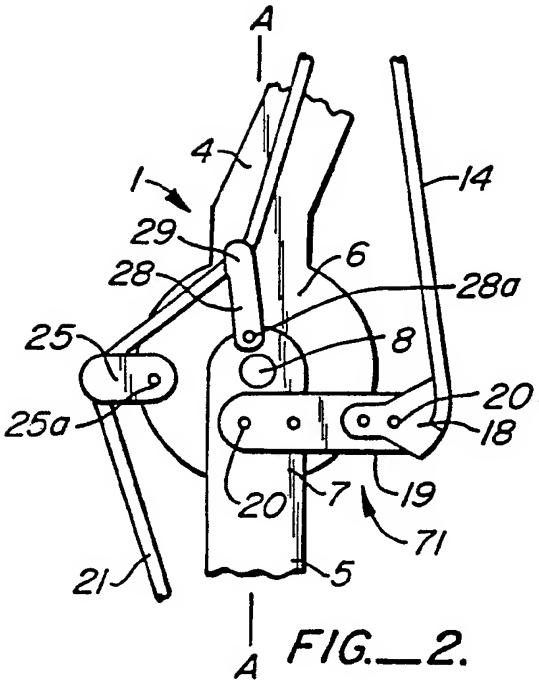

FIG.__2.

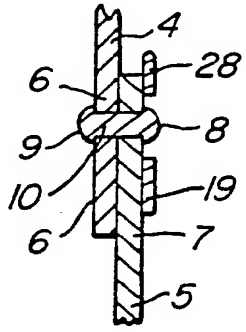

FIG.__3.

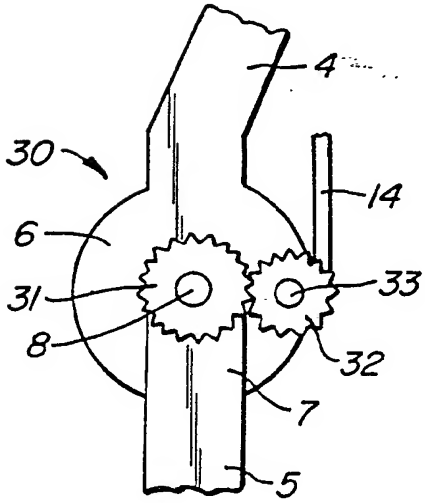

FIG.__4.

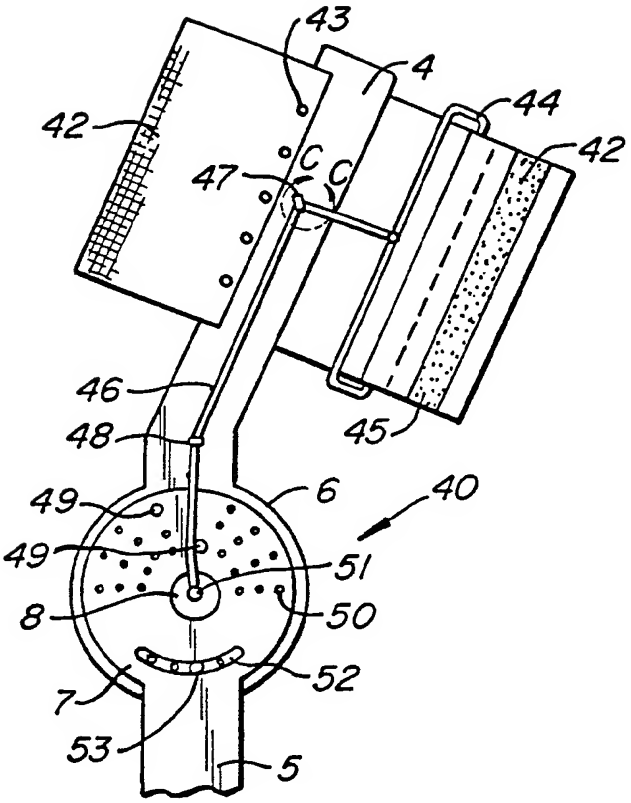

FIG._5.

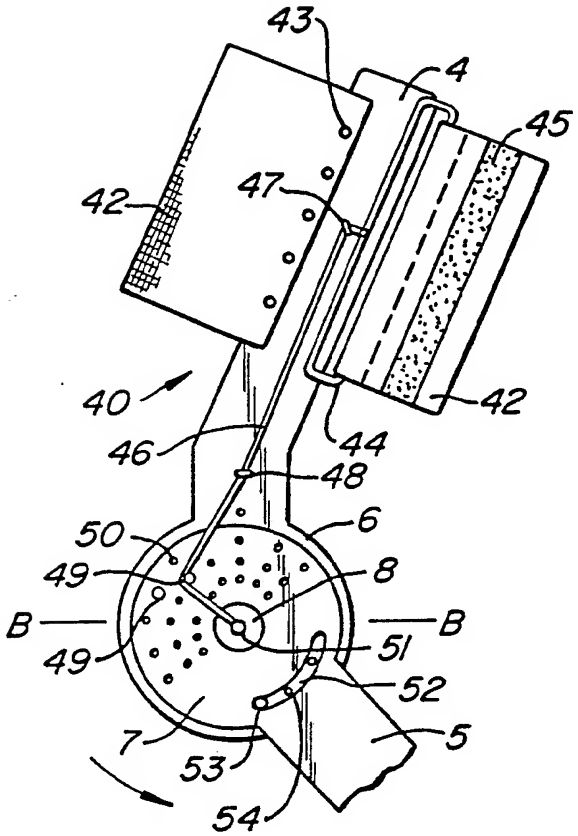

FIG._6.

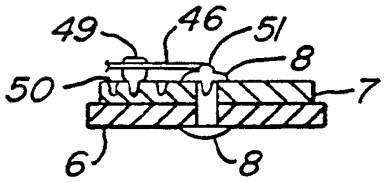

FIG._7.

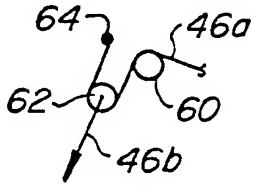

FIG._8.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US86/02791

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (4): A61F 5/04, 2/78, 5/01
U.S. Cl. 128/80C, 88, 80F; 623/32

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	128/80C, 80F, 80G, 88 623/32, 39, 40, 50, 51 2/22, 24

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 2,195,024 (BULLOCK) 26 March 1940 See page 2, line 30 through page 3, line 21.	29, 31
Y	US, A, 2,558,986 (SEELERT) 03 July 1951 See column 3, lines 33-41, column 4, lines 7-21, column 5, lines 9-28 and Figure 1.	30
Y	US, A, 4,506,661 (FOSTER) 26 March 1985 See Figures 1, 2, and 5 and column 3, lines 35-48.	30
A	US, A, 73,768 (ALLEN) 28 January 1868 See Figures 1 and 2, and page 2, lines 9-13 and lines 33-44.	
A	US, A, 4,320,747 (DANIELL, JR.) 23 March 1982, see column 5, lines 21-64.	
A	US, A, 1,601,659 (VAN HARLINGEN) 28 September 1926, see entire document.	

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]

10 March 1987

Date of Mailing of this International Search Report [2]

18 MAR 1987

International Searching Authority [1]

ISA/US

Signature of Authorized Officer [20]

Tonya Lamb

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	US, A, 4,088,130 (APPLEGATE) 09 May 1978 See entire document.	
A	US, A, 4,220,148 (LEHNEIS) 02 September 1980, see entire document.	
A	US, A, 4,340,041 (FRANK) 20 July 1982 See entire document.	
A	US, A, 4,361,142 (LEWIS ET AL.) 30 November 1982, see entire document.	

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [10]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ..... because they relate to subject matter [12] not required to be searched by this Authority, namely:

2. ☐ Claim numbers ..... , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [13], specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [11]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.